Y-splitters in photonic wires and photonic crystal waveguides

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Development of wide-angle Y-splitters with micron-scale footprint areas is crucial for implementing dense optical integrated circuits. We compare the transmission bandwidth, return losses and total losses of 60˚ splitters based on W1 photonic crystal (PhC) waveguide with those of resonant 90˚ T-type and quasi-adiabatic 15˚ Y-splitters based on photonic wires. We find that for a non-optimized 60˚ PhC splitter the losses are around 6-7dB/split. Its low-loss spectral bands are separated by narrow bands with over 30dB higher attenuation. These high-loss bands correspond to the building up of strongly resonant modes (Q~800) due to intense back-reflections. Although it is possible to decrease the splitting losses by optimizing the structure's topology, the existence of these lossy resonant modes is intrinsic to highly resonant structures such as PhC waveguides. To solve this problem we study Y-splitters based on photonic wires with a footprint even smaller than that of a PhC-based device. The use of a low-Q resonant structure forming a 90˚ T-splitter minimizes the back-reflections and results in a nearly flat transmission spectrum over 200nm in bandwidth and with losses of only 2.6±0.7dB/split. Surprisingly, the quasi-adiabatic non-resonant Y-splitter provides even better performance with the total losses below 0.7dB/split.